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(72) Inventors RUSSELL WILLIAM WALTERS
RICHARD MAURICE BRATTLAND

(19)

(54) CYLINDER LOCK

(71) We, KEYSTONE CONSOLIDATED INDUSTRIES, INC., a corporation duly organized and existing under the laws of the State of Delaware, United States of America, of 411 Hamilton Boulevard, Peoria, State of Illinois, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a cylinder lock.

In the recent U.S. Patent No. 3,422,646 is disclosed a lock structure having axially movable pin tumblers which are actuated by a hollow cylindrically shaped key where the lock structure included a plurality of tumblers, a plurality of change tumblers or wafers, and locking pins corresponding to the number of tumblers. The change tumblers or wafers provide for easily changing the lock setting to be actuated by a differently bitted key through the use of a change key and change position of the lock. The present invention relates to improvements in pin tumbler locks, especially of the axially movable tumbler type, to enhance the security of the lock and the ease of key actuation.

According to the invention, there is provided a lock comprising a lock cylinder having a passage therethrough, a rotatable barrel assembly received in said passage and having a key receiving space therein, an index ring located in said lock cylinder encircling a part of said barrel assembly means securing said index ring in said lock cylinder, said index ring having a plurality of radial openings therein, said barrel assembly having a like number of radial openings therein aligned with the radial openings in said index ring, a pin received in each of said radial openings in the barrel assembly and projecting into said key receiving space, and means biasing said pins inwardly to engage the exterior surface of a key and allow rotation of said barrel assembly relative to said index ring and lock cylinder. Preferably, said index ring openings include openings spaced around and extending radially through said index ring and disposed in alignment with respective ones of said barrel assembly openings, said index ring having an annular groove on the exterior surface thereof intersecting the spaced openings therethrough, and said pins include sets of anti-torque pins and drivers therefor received in the openings through the index ring and respectively aligned ones of said barrel assembly openings, said anti-torque pins projecting into said key-receiving space with said pins and drivers intersecting a shear line defined between said index ring and said barrel assembly, said anti-torque pins and drivers being movable to a non-intersecting position by a key.

Preferably, said plug assembly includes a generally cylindrical plug nose extending into said key receiving space, a plurality of circumferentially spaced longitudinally extending ribs formed on said plug nose, said lock including a key adapted to enter said key-receiving space and provided with a hollow key barrel encompassing said plug nose and having longitudinally extending grooves on the interior surface thereof receiving said ribs.

The lock may include axial pin tumblers and a change key may be provided to alter the setting of the pin tumblers by rotation to a change position. Suitable keys for the lock are described and claimed in our co-pending Application No. 22352/74 (Serial No. 1 376 012).

A greater understanding of the invention may be had by reference to the following description and the accompanying drawings in which:

Figure 1 is a side elevational view of the

withdrawn key and the pin tumbler lock assembly mounted in a suitable door.

Fig. 2 is a front elevational view of the lock assembly showing the cooperation of the lock bolt with a strike member.

Fig. 3 is an exploded perspective view of the lock assembly.

Fig. 4 is a top plan view of the lock assembly and a partial view of the key.

Fig. 5 is an enlarged front elevational view of the lock assembly with portions broken away to show the retaining pins.

Fig. 6 is a vertical cross sectional view taken on the line 6-6 of Fig. 5.

Fig. 7 is a horizontal cross sectional view taken on the line 7-7 of Fig. 5.

Fig. 8 is a rear elevational view of the lock assembly with the lock bolt, washer and split retainer ring on the shaft.

Fig. 9 is a cross sectional view taken on the line 9-9 of Fig. 5 with the lock rotated to the change position.

Fig. 10 is a front elevational view of the index ring for the lock assembly.

Fig. 11 is a horizontal cross sectional view taken on the line 11-11 of Fig. 10.

Fig. 12 is a front elevational view of an alternate embodiment of index rings.

Fig. 13 is a horizontal cross sectional view taken on the line 13-13 of Fig. 12.

Fig. 14 is a front elevational view of a second alternate embodiment of index ring.

Fig. 15 is a horizontal cross sectional view taken on the line 15-15 of Fig. 14.

Fig. 16 is a side elevational view of a pass key for the lock assembly.

Fig. 17 is an end elevational view of the key of Fig. 16.

Fig. 18 is a side elevational view of the key of Fig. 16 partially broken away to show the retaining pin depressions.

Fig. 19 is a side elevational view, partially broken away, showing a change key for the lock.

Fig. 20 is an end elevational view of the key of Fig. 19.

Referring more particularly to the disclosure in the drawings wherein is shown an illustrative embodiment of the present invention, Fig. 1 discloses a pin tumbler lock assembly 10 for the actuation of a suitable lock bolt 11 or other locking mechanism, the lock assembly being inserted in an opening adjacent the edge of a door 12 and retained therein by a nut 13 threadingly engaging the threaded exterior surface 14 of a lock cylinder 15. The lock cylinder 15 includes a generally cylindrical body having oppositely disposed flattened portions 16, 16 to be received in a complementary opening to prevent rotation of the cylinder 15 relative to the door 12, and an enlarged flange 17 providing a face 18 for the lock assembly and a shoulder 19 engaging the exterior surface of the door 12. The lock bolt 11 cooperates or engages with a suitable strike member 20.

The lock cylinder 15 is provided with a generally cylindrical passage 21 therethrough counterbored at 22 within the flange 17 and further counterbored at 23 at the face 18 of the cylinder. A pair of diametrically opposed longitudinally extending grooves or slots 24, 24 are formed in the passage 21 with the maximum distance between the bottom surfaces of the slots being less than the diameter of the counterbore 22. The flange 17 is provided on its exterior generally conical surface with an indexing mark 25 indicating the vertical position for the cylinder and a pair of spaced secondary indices 26, 26, one of which indicates the change position for the lock. At the opposite end, a lug 27 extending for a suitable arc of travel around the cylinder aids in limiting rotary movement of the lock bolt 11.

Within the lock cylinder 15 are located a rear cylindrical barrel 28, a center generally cylindrical barrel 29 having a pair of diametrically opposed longitudinally extending ribs 30, 30 received in the grooves 24, 24 of the lock cylinder 15, and a cylindrical front barrel 31 having a slight enlargement 32 and an end flange 33 received in the counterbore 23. A plug shaft 34 extends through central openings 35 in the barrels 28, 29 and 31 and terminates at the forward end in a plug nose 36 in a cylindrical chamber 37 in the barrel 31, the nose having a smooth cylindrical surface with three longitudinally extending and circumferentially equally spaced ribs 39 extending from the rear wall 38 of the chamber to an inclined surface 40 terminating the rib approximately one-half the distance from the wall 38 to the conical end 41 of the nose.

The plug shaft 34 extends rearwardly from the rear barrel 28 and the rear end of the lock cylinder 15 providing a cylindrical surface 42 (Fig. 8) with opposed flattened sides 43, 43 and a generally annular groove 44 intersects the sides 43, 43, at a point spaced from the rear end of the shaft. A stop washer 45 having a central opening complementary to the cylindrical surface 42 and flattened sides 43, 43 is mounted on the shaft abutting the end of the cylinder 15; the lock bolt 11, also having an opening conformably receiving the shaft, abuts the washer, and a spring retainer ring 46 or other suitable means engages in the groove 44 to retain the lock bolt 11 and stop washer 45 on the shaft. A washer 47 is located on the plug shaft 34 abutting a shoulder on the plug nose 36 and received in a recess 48 (Fig. 6) in the front barrel 31.

The stop washer 45 may have any suitable peripheral configuration, such as lugs 48', to cooperate with the arcuate projection

or lug 27 to limit the arc of travel of the lock bolt 11 to 90° or 180°, or the washer may not have a lug to allow a 360° rotation of the lock bolt. The front barrel 31 and the rear barrel 28 are secured to the plug shaft 34 by pins 49 and 50, respectively, extending diametrically through openings 51, the shaft 34 and projecting into openings 51' in the barrels 28 and 31; the pins being frictionally retained in the shaft and barrels. Thus, the shaft 34 and front and rear barrels 31 and 28, respectively, rotate simultaneously while the center barrel 29 is stationary in the lock cylinder 15.

As previously known from the U. S. Patent No. 3,422,646, the front barrel 31 and rear barrel 28 are provided with a plurality of aligned circumferentially equally spaced and axially extending passages 52, 53, shown as six in number. The center barrel 29 has twice as many circumferentially equally spaced axially extending passages 54, 54'. With the lock assembly 10 in locked position and the key inserted, the passages 52 in the front barrel 31 each contains a tumbler 55, the aligned passages 54 in the center barrel 29 contain the locking pins 56, the alternate passages 54' in the center barrel contain the change tumblers 57, and the passages 53 in the rear barrel 28 contain change tumblers 57 and tumbler springs 58.

With the proper key inserted, the shear lines 59, 59 between the three barrels are aligned with the shear lines defined by the tumblers 55, locking pins 56 and change tumblers 57, while with the key retracted the locking pins 56 extend over one of the two shear lines 59 to prevent rotary movement. The plurality of change tumblers 57 are provided so that when the lock is moved to the change position to be later described, the arrangement of the change tumblers in the passages 52 and 53 can be altered.

Located within the chamber defined by the counterbore 22 is an index ring 61 encompassing the forward end of the front barrel 31; the index ring having a generally annular configuration with an annular groove 62 in the outer surface and a pair of oppositely disposed rearwardly extending ribs 63, 63 which extend into the grooves 24, 24 in the lock cylinder 15 so that the ring is stationary in the lock cylinder. The index ring 61 has a cylindrical passage which is counterbored to provide a shoulder 64 cooperating with the shoulder formed on the enlargement 32 of the front barrel 31 and spacing the index ring from the flange 33.

In the front edge of the index ring 61 (Figs. 3, 10 and 11) are formed a pair of diametrically opposite notches 65, 65 and a pair of secondary notches 66, 66 are formed in the same edge, one at each side of and circumferentially spaced from the upper notch 65. A pair of diametrically opposite stepped openings 67, 67 are formed in the front barrel 31 in alignment with the opposed notches 65, 65 to receive a pair of retaining pins 68, 68 therein. A resilient O-ring 69 is positioned (Fig. 6) in the space between the index ring 61 and the flange 33 and engages the outer ends of the retaining pins 68. Each pin 68 has a reduced diameter inner shank portion 71 in the stepped opening with a rounded end 72 projecting into the chamber 37 to engage a suitable key to be later described.

Rearwardly of the notches 65, 65, 66, 66 is located the groove 62 receiving a second resilient O-ring 73. Aligned with the groove 62 are a second pair of radial openings 74, 74 which are normally aligned with stepped radial openings 75, 75 in the front barrel 31. No more than one of the radial openings 74 is longitudinally aligned with a notch 65. Therefore, as shown in Figs. 6, 10 and 11, the radial openings 74, 74 and 75, 75 are spaced from each other at an angle of 120°. As seen in Fig. 10, the upper notch 65 and upper radial opening 74 are longitudinally aligned at a twelve o'clock position and the second opening 74 is at a four o'clock position.

The radial openings 74, 74 (Fig. 6) each receive a driver 76 engaging the resilient O-ring 73 extending across and into the openings. Each stepped opening 75 receives an anti-torque pin 77 having a reduced diameter inner end 78 projecting into the chamber 37 to engage the exterior surface of a proper key 79 (Fig. 16). When the proper key is inserted into the lock, the exterior surface 83 of the key 79 will engage the rounded end 78, 78 of the anti-torque pins 77, 77 and urge the pins 77, 77 and drivers 76, 76 outwardly against the force of the O-ring 73 to align the shear line defined by the line of contact between each driver and anti-torque pin with the shear line defined between the index ring 61 and the front barrel 31 so that the anti-torque pins or drivers will not interfere with rotation of the front barrel 31 and the plug nose 36 and shaft 34 relative to the index ring 61 and the lock cylinder 15.

As seen in Figs. 12, 13, 14 and 15, the openings in the index ring 61 for the anti-torque pins can be arranged in numerous locations, as well as others not shown. In Figs. 12 and 13, the radial openings 74', 74' for the index ring 61' are arranged at the two o'clock and ten o'clock positions. The notches 65', 65' and secondary notches 66', 66' remain at the positions shown in Figs. 5, 6, 10 and 11. In Figs. 14 and 15, the index ring 61' has identically positioned notches 65', 65' and secondary notches 66', 66', but the radial openings 74', 74' are located at the two o'clock and four o'clock

positions. Obviously, the radial openings 75, 75 in the front barrel 31 would be suitably aligned with the openings 74ᵃ, 74ᵃ or 74ᵇ, 74ᵇ. Other possible positions of the openings 74, 74 include the combinations of 1) twelve o'clock and eight o'clock, 2) four o'clock and eight o'clock, 3) twelve o'clock and two o'clock, 4) twelve o'clock and ten o'clock, 5) eight o'clock and ten o'clock, 6) two o'clock and eight o'clock, and 7) four o'clock and ten o'clock.

Now considering the key 79 (Figs. 16, 17 and 18) utilized for actuation of the lock, the key includes a flat key bow 81 of any suitable periphery for ease of handling and a hollow key barrel 82 which is generally cylindrical with an exterior surface 83 and an interior generally cylindrical surface 84 interrupted by three circumferentially equally spaced longitudinally extending grooves 85 extending the length of the barrel. The bow 81 is secured to the barrel by inserting the bow through a diametrically extending slot 86 and a pin or rivet 87 extends through aligned openings in the barrel 82 and the bow 81 and suitably secured therein. At the forward end of the key barrel are provided suitable key bittings 88 which engage and cooperate with the lock tumblers 55 to actuate the tumbers so that the plug shaft 34, the plug nose 36, the front barrel 31, the rear barrel 28, and the lock bolt 11 can rotate relative to the lock cylinder 15.

The exterior surface 83 of the barrel 82 has a pair of oppositely disposed depressions 89, 89 which are adapted to be aligned with the rounded ends 72 of the retaining pins 68 so that the resilient O-ring 69 will urge the retaining pins 68 inwardly to solely reside in the front barrel 31 and not obstruct rotation of the front barrel 31 relative to the index ring 61. If the depressions 89, 89 are not present or are not of the proper depth, the retaining pins 68 will be moved into the notches 65, 65 in the index ring to prevent rotation of the front barrel 31 and associated structure. Once the proper key has been inserted and rotated so the retaining pins 68 are no longer aligned with the notches 65, 65, the engagement of the retaining pins 68 in the depressions 89, 89 prevents removal of the key; the inner surface of the counterbored passage in the index ring 61 preventing any outward movement of the retaining pins 68. Also, the surface 83 may have any suitable configuration aligned with and actuating the anti-torque pins 77 and drivers 76 to allow rotation of the barrel 31.

Figs. 19 and 20 disclose a set or change key 91 having a key bow 92 secured to a hollow cylindrical key barrel 93 by a pin 94 passing diametrically therethrough. The barrel 93 has internal longitudinally extending grooves 95 and the external key bittings 96 and one retaining pin depression 97 shown at the top of the barrel 93 in Fig. 19. However, instead of the opposite depression, the barrel is provided with a slot or groove 98 of the same depth as the depression 97 and extending from the bitted end 99 of the barrel to a point aligned with the depression 97. Thus, when the key 91 is rotated to the change position shown in Fig. 9, the upper retaining pin 68 is aligned with one of the secondary notches 66 in the index ring 61, and the lower pin 68 is in the groove 98. The key 91 can then be withdrawn and a change key with a different bitting inserted and rotated to normal position.

In operation with the lock assembly 10 in normal locked position, a proper key 79 is inserted into the chamber 37 surrounding the plug nose 36 with the bittings 88 engaging the tumblers 55 and forcing them rearwardly against the force of the springs 58, and the exterior surface 83 of the key barrel 82 engages the ends 72 of the retaining pins 68 to force them outward against the force of the O-ring 69 into the opposed notches 65, 65, and engage the ends of the anti-torque pins 77 and force these pins 77 and drivers 76 outward against the force of the second O-ring 73 in the groove 62.

As the key enters, the longitudinal ribs 39 on the plug nose 36 enter the complementary grooves 85 in the key barrel 82 so the key and plug nose will rotate together. When the key 79 has reached a position abutting the rear wall 38 of the chamber 37, the retaining pins 68, 68 are aligned with and biased into the depressions 89, 89 in the key barrel so that the retaining pins 68 are solely within the openings 67, 67 in the barrel 31, the shear line of the anti-torque pins 77 and drivers 76 is aligned with the shear line of the index ring 61 and barrel 31, and the shear lines of the locking pins 56, tumblers 55 and change tumblers 57 are aligned with the shear lines 59 of the center barrel so that the key 79, plug nose 36, plug shaft 34, front barrel 31, rear barrel 28, the stop washer 45 and the lock bolt 11 can rotate within the limits imposed by the washer 45 and the projection 27 on the lock cylinder 15 to move the bolt between locked and unlocked positions. Because of the retaining pins 68, 68 in the depressions 89, 89, the key 79 cannot be removed until the lock is returned to its original locked position.

To change the arrangement of the change tumblers 57 relative to the tumblers 55 and the locking pins 56, a change key 91 is utilized. Starting with the lock assembly 10 in its locked position, the change key 91 having the proper bittings for the lock is inserted into the chamber 37 and actuates the retaining pins 68, the anti-torque pins 77

and drivers 76 and the tumblers 55 in the manner previously described, except the lower retaining pin 68 is not moved because of the longitudinal groove 98 on the exterior surface of the key barrel 93. Once the key is fully inserted and the grooves 95 in the key barrel 93 engage the ribs 39, the key 91 is rotated through an arc of 30° so that the bow 92 is aligned with a secondary index mark 26. At this point, the upper retaining pin 68 is aligned with a secondary notch 66 in the index ring 61, and the passages 52 and 53 in the front barrel 31 and the rear barrel 28, respectively, are aligned with the alternative passages 54' in the center barrel 29 providing a line of change tumblers 57 as seen in Fig. 9. The key 91 is then removed as allowed by the secondary notch 66 and the slot 98 in the key barrel 93 with the tumbler springs 58 forcing the tumblers 55 and change tumblers 57 forwardly.

A new key 91 having different key bittings 96 is then inserted into the lock 10 in the change position to reset the tumblers 55 and change tumblers 57 in a new arrangement, as more clearly disclosed in the U. S. Patent No. 3,422,646, and the key is rotated to the locked position where the key bow 92 is aligned with the primary index mark 25, and the key is removed. Then a new key 79 having bittings 88 identical to those of the new change key 91 may be used to actuate the lock and rotate the lock bolt 11 between locked and unlocked positions as seen in Fig. 2.

WHAT WE CLAIM IS:—

1. A lock comprising a lock cylinder having a passage therethrough, a rotatable barrel assembly received in said passage and having a key receiving space therein, an index ring located in said lock cylinder encircling a part of said barrel assembly, means securing said index ring in said lock cylinder, said index ring having a plurality of radial openings therein, said barrel assembly having a like number of radial openings therein aligned with the radial openings in said index ring, a pin received in each of said radial openings in the barrel assembly and projecting into said key receiving space, and means biasing said pins inwardly to engage the exterior surface of a key and allow rotation of said barrel assembly relative to said index ring and lock cylinder.

2. A lock as set forth in claim 1, in which said index ring openings include circumferentially spaced notches formed in the front edge of said index ring and disposed in alignment with respective stepped ones of said barrel assembly openings, and said pins include stepped retaining pins biassed into said stepped openings, whereby the exterior surface of an improper key will force the retaining pins outwardly into said notches to block rotation of said barrel assembly.

3. A lock as set forth in either of claims 1 or 2 in which said index ring openings include openings spaced around and extending radially through said index ring and disposed in alignment with respective ones of said barrel assembly openings, said index ring having an annular groove on the exterior surface thereof intersecting the spaced openings therethrough, and said pins include sets of anti-torque pins and drivers therefor received in the openings through the index ring and respectively aligned ones of said barrel assembly openings, said anti-torque pins projecting into said key-receiving space with said pins and drivers intersecting a shear line defined between said index ring and said barrel assembly, said anti-torque pins and drivers being movable to a non-intersecting position by a key.

4. A lock as set forth in claim 2, in which said biasing means includes a first resilient ring encircling said barrel assembly adjacent said notches and engaging the outer ends of said stepped retaining pins.

5. A lock as set forth in claim 4, in combination with a proper key having an external surface with depressions aligned with and receiving the inner ends of said retaining pins so that the retaining pins solely reside in said barrel assembly to allow rotation thereof within said lock cylinder.

6. A lock as set forth in claim 3 when appended to claim 1, in which said openings through said index ring are formed on a circumference spaced rearwardly of said notches.

7. A lock as set forth in claim 6, in which said biasing means includes a second resilient ring received in said annular groove and engaging said drivers, such that the external surface of a proper key will engage the inner ends of said anti-torque pins and position said anti-torque pins and drivers so that the line of contact therebetween coincides with the shear line between the index ring and the barrel assembly to allow rotation of the key and barrel assembly.

8. A lock as set forth in claim 7, in which no more than one of said anti-torque pins is in alignment with a retaining pin longitudinally of the barrel assembly.

9. A lock as set forth in any preceding claim, in which said securing means includes a pair of rearwardly extending projections on said index ring, said lock cylinder having a pair of longitudinally extending grooves in said passage receiving said projections.

10. A lock as set forth in claim 1, in

which said radial openings in said index ring comprise a pair of oppositely disposed notches at the front edge of said index ring and a pair of spaced radial openings on a circumference spaced rearwardly of said notches, said index ring having an annular groove on its exterior surface intersecting said pair of spaced radial openings, a first resilient O-ring encircling said barrel assembly adjacent said notches, and a second resilient O-ring received in said annular groove, said barrel assembly having radial openings aligned with said opposed notches and said radial openings in said index ring, a pair of retaining pins received in said openings in the barrel assembly aligned with said notches and engaging said first resilient O-ring and a pair of anti-torque pins and drivers in said aligned radial openings in said index ring and barrel assembly, the inner ends of said retaining pins and anti-torque pins projecting into said key receiving space to engage an exterior surface of a proper key.

11. A lock as set forth in claim 10, in which no more than one of said anti-torque pins is in alignment with a retaining pin longitudinally of the barrel assembly.

12. A lock as set forth in claim 10, in which none of said anti-torque pins is in alignment with a retaining pin longitudinally of the barrel assembly.

13. A lock as set forth in claim 10, in combination with a key which has an exterior surface engaging said anti-torque pins to align the meeting lines of the anti-torque pins and drivers with the shear line between said index ring and barrel assembly, said exterior surface having a pair of diametrically opposed depressions receiving the inner ends of said retaining pins to allow the retaining pins to be retracted within said barrel assembly.

14. A lock as set forth in claim 10, including axial pin tumblers, said barrel assembly being shiftable between a locked position and a tumbler changing position, said index ring having at least one secondary notch spaced from one of said opposed notches and aligned with a radial opening in said plug assembly in the tumbler changing position, and including a key for operating said lock, said key having an exterior surface with a depression and an oppositely disposed longitudinally extending slot for receiving said retaining pins.

15. A lock as set forth in claim 1, in which said plug assembly includes a generally cylindrical plug nose extending into said key receiving space, a plurality of circumferntially spaced longitudinally extending ribs formed on said plug nose, said lock including a key adapted to enter said key-receiving space and provided with a hollow key barrel encompassing said plug nose and having longitudinally extending grooves on the interior surface thereof receiving said ribs.

16. A lock substantially as herein described with reference to the accompanying drawings.

For the Applicants:
FRANK B. DEHN & CO.,
Charered Patent Agents,
Imperial House,
15-19 Kingsway,
London, WC2B 6UZ.

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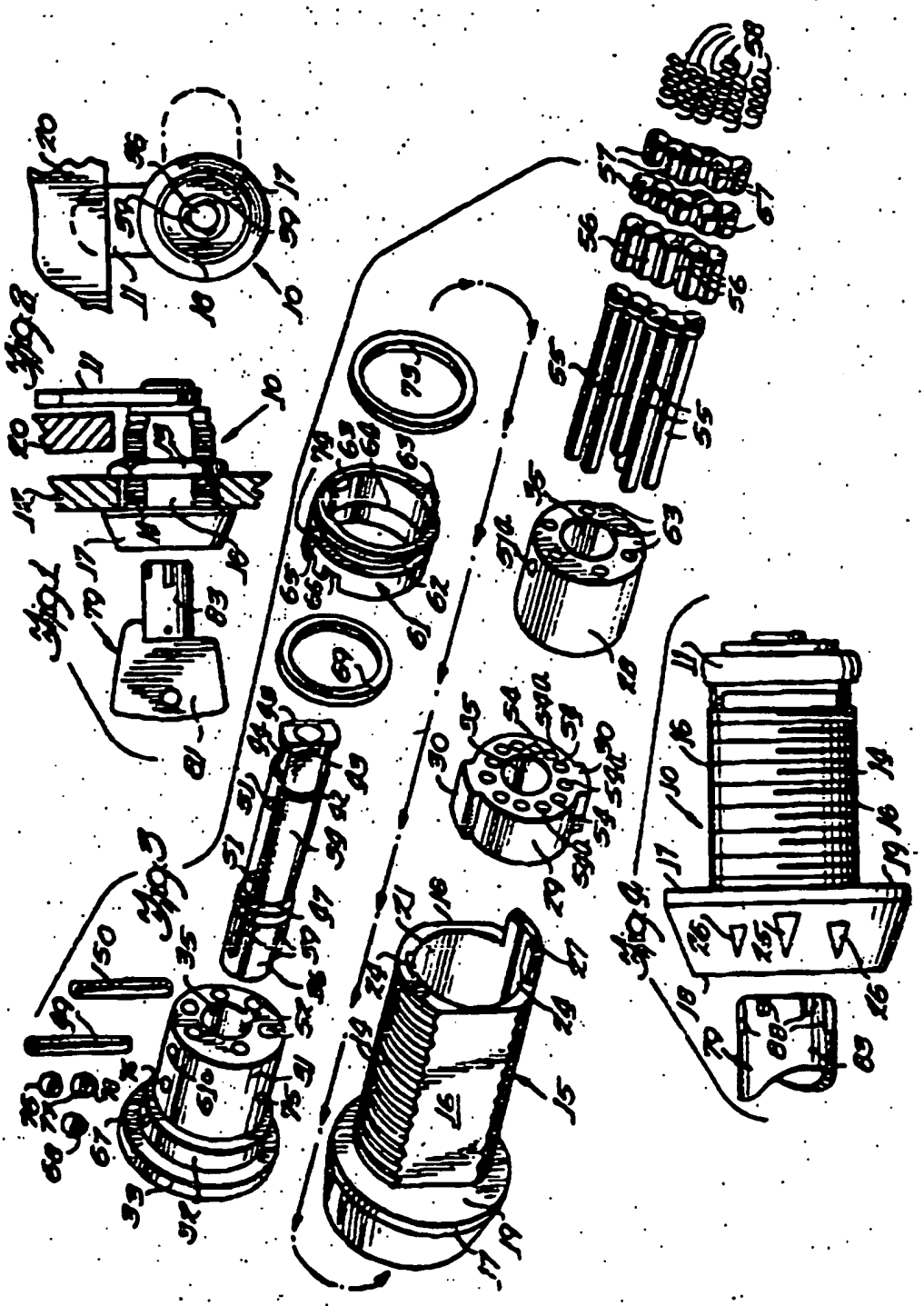

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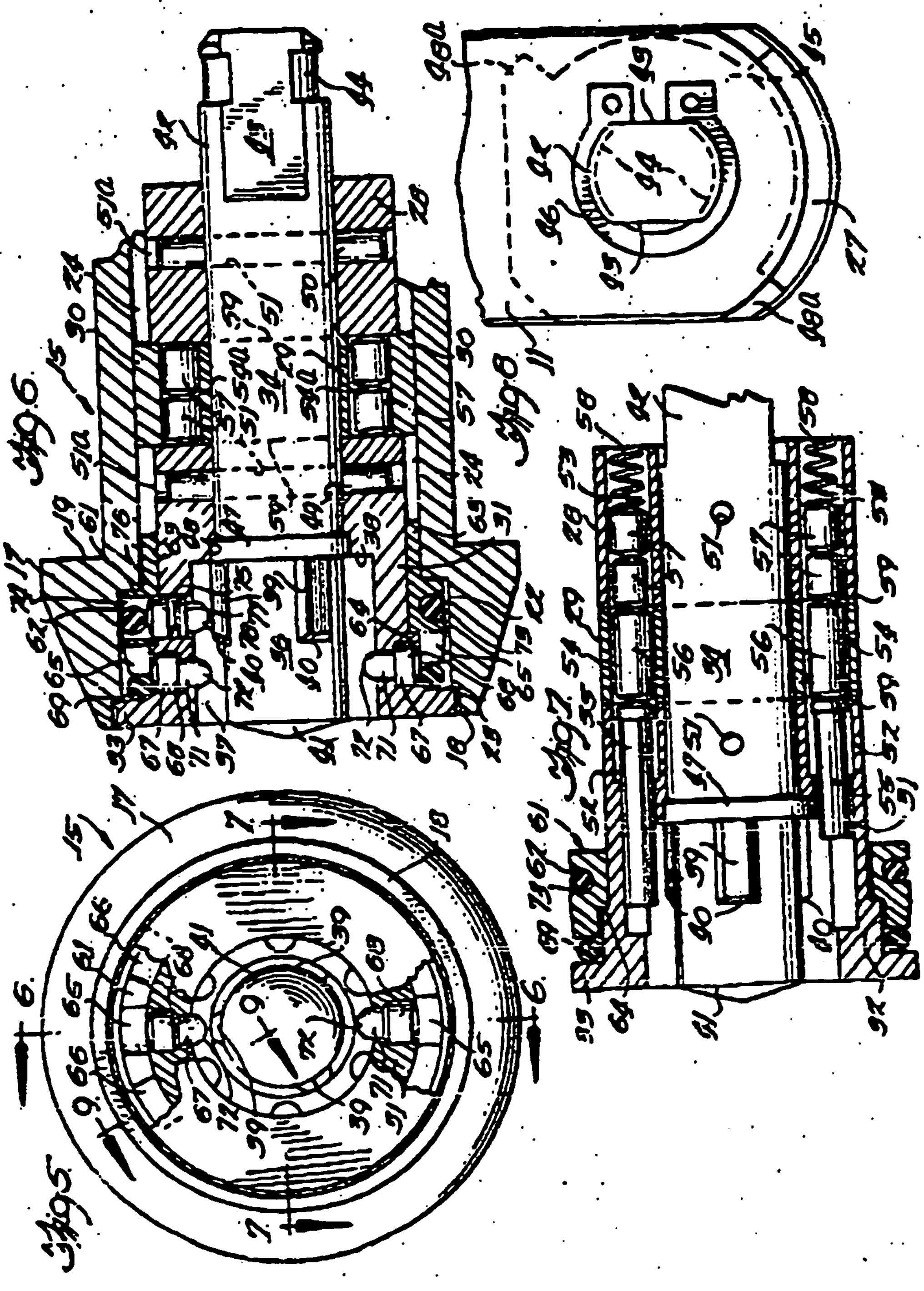

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